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Estimation of radon and uranium concentrations in some selected wells water in Salahuddin province, Iraq

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Abstract:

Eight regions in Salah Uddin province in Iraq were chosen to study the radioactivity concentration in the well's water, by using Long-term technique for alpha particles emission with solid state nuclear track detector (SSNTD) CR-39 to determine the radioactive isotopes concentrations in the samples. A sodium iodide scintillation detector with multichannel analyzer (MCA) was used to measure the activity of samples. The result shows that among the eight samples the maximum average radioactive in Shrqat city was measured to be (9.335, 0.994, 1.320, 2.184) $Bq.L^{-1}$, while the minimum average in Balad city was (6.875, 0.589, 0.979, 1.226) $Bq.L^{-1}$. In general it has been found that (^{40}K, ^{238}U, ^{222}Rn and ^{226}Ra) concentration, in the studied water samples, was less than allowed permitted limit which is about 18 $Bq.L^{-1}$, so it has no danger on human being life.

Key words: Ground Water, Natural radioactivity

INTRODUCTION

Natural radionuclides are present in varying amounts in air, water, plants, animals, soil and rocks. Naturally occurring radionuclides and particularly their decay products are transported in ground and surface water. Uranium for instance is found in ground and surface waters due to its natural occurrence in geological formations. The average uranium concentrations in surface, ground, and domestic water are 1, 3 and 2 pCi/L, respectively. The uranium intake from water is equal to the total from other dietary components [1]. As a result, these other radio nuclides may enter the food chain through irrigation waters, and the water supply through groundwater wells and surface water streams and rivers [2].

The activity concentration of natural radionuclides in groundwater is connected to the activity concentrations of uranium (^{238}U, ^{235}U), thorium (^{232}Th) and their decay products in the ground and bedrock. This is due to groundwater reacting with the ground and bedrock and releasing quantities of dissolved components that depend on the mineralogical and geochemical composition of the soil and rock, chemical composition of the water, the degree of weathering of the rock, redox conditions and the residence time of ground water in the soil and bedrock. Natural radionuclides in the Finnish groundwater originate mainly from the decay series of ^{238}U [3, 4, 5 and 6]. The most harmful of these, from the point of view of radiation protection, is ^{222}Rn. Other alpha-active isotopes includes ^{238}U, ^{234}U, ^{210}Po and ^{226}Ra. In addition, beta-emitters ^{210}Pb, ^{228}Ra and ^{40}K isotopes are also found in drinking water. The isotope ^{228}Ra originated from the decay series of ^{232}Th. In addition to the radiation dose from the ingested ^{222}Rn, the water-born ^{222}Rn is a source of indoor air during water usage, inhaled ^{222}Rn daughters affect lungs. The purpose of the study is to gather information about the natural radiation concentration throughout. This is motivated by the concern about the possible consequences of long term exposure to higher concentration Radon and its short-lived product in air. Since, it is known that Radon through its radioactive progeny can cause lung cancer, and thus has become a public health concern.

METHOD AND MATERIAL

In this study the result from randomly selected 48 dug wells used as sources of drinking water and farming are reported, the result on water work are based on over more method from water work. In order to obtain representation estimates for average radionuclide concentrations in the consumed water the proportion of surface and ground water at each individual water work were taken into account. The data base of the Iraq Environment Ministry was utilised in calculation the missing values for ^{40}K, ^{238}U, ^{226}Ra and ^{222}Rn were obtained with regression analysis using the values of gross alpha, gross beta and ^{222}Rn as explanatory variables [7]. to obtain values for water work without any measurements means from water work using the same water type (ground water from soil and ground water from rocks) and by using two method to measures the sample, A "3*3" sodium iodide scintillation detector with multichannel analyzer (MCA) was used to measure the activity of samples. The energy calibration was performed using a set of standard gamma ray calibration sources Eu-152 and using technique for alpha particles emission with solid state nuclear track detector (SSNTD) CR-39, depended on measuring long term to record effect of alpha particles that emitted from ^{222}Rn that consider natural product for deluge ^{238}U. 6 cases are taken from each sample, the number of sample 8 to be the number of cases equal to 48 cases. We take the weight for the cases to be 250mL^{-1} then placed in rooms for radiating. We used the reagent (CR-39) in equal distance (1x1 cm^2). The radiation room consists of plastic cup of diameter (r = 3.2 cm) and depth of (d = 5.3cm), the cover was with upper hole of 0.9cm. The internal cover with piece of sponge has distance (2x2cm) and depth of 0.5cm, the arrangement is very necessary to follow the standard condition in order to prevent non-gas daughters of radon from activation, ^{222}Rn go in cup where allowing for radon gas to pass through. We used NaOH (sodium hydroxide) 98% and temperature 70 $\pm$ 1C^{o} to show the traces in plastics reagent. The process of removing occur when sink the pieces of radical reagent in removing solution in cups formed or preparing for removing in water path under removing condition that mentioned above to prevent evaporation the covers must be closed accurate way that formed in solution to still the concentration in removing processes. After a few minutes the reagent pieces remove from solution and washed with distill water to remove any precipitates come from solution and then dry by using smooth paper to begin microscopic show and measure distance of trace that formed. The cases are taken from area and region in Salahhudin to measure radical activity in water of well and the number of water cases equal to 8 case divided as show in Table (1), Figs (2,3,4,5) shows the spectral shapes in three selected regions i.e., Shrqat, Bieja and Tikrit, also the background radioactivity in Salahuddin governorate.

STUDY AREA

Salahuddin governorate lies in the middle of Iraq and forms the governorate in Iraqi Region Fig. (1). It confines with Kirkuk and Nineveh from the north, Alanbar from the west, Deyala governorate from the east, and Baghdad governorate from the south. It is a part of the mountain and semi-mountain that orientated from west to east, in physiographic diversity from the middle and south of Iraq. The governorate is divided into the following eight districts: district with Tikrit, Bieja, Dour, Samara, Shrqat, Tuz, Balad and Dujaeil. The climate of the Region is of semi-arid type, designated as continental and subtropical. The elevation is quite different ranging from lower than 10 to more than 150 meters above the sea level. During the summer, the average temperature does not normally exceed 45 ^{o}C at its peak and drop below 5 ^{o}C in winter. The geological formations consisting of limestone, red beds of silt, hard clay stone with some beds of siltstone and conglomerate and formation of well bedded chalky, partly dolomite limestone with thin beds of yellowish-green marl. Soil Quality; the area is generally characterized by thick sedimentary cover and well-marked folds of asymmetrical anticlines and broad synclines. The area is entirely located within the low folded zone. This soil throughout investigation is classified as soil of a very low permeability, moisture of sediment of depth from (5 to 10cm). All the natural water resources come from rains, and grounds waters and superficial water to present the actual water sources of Salahuddin governorate. Superficial water is considered the main source to the governorate. Most of the irrigated lands at the bottom of the valleys are irrigated by rivers, streams and springs. However, small diesel pumps are used to lift water from the existing streams to strips of lands along these streams [8]

RESULT AND DISCUSSION

Table (1) demonstrates the result for each of ^{40}K, ^{238}U, ^{222}Rn, ^{226}Ra of the mean activity concentration in Bq.L^{-1} that obtained from the well water for eight selected regions it shows that the mean activity concentration for each radionuclide ranged the maximum in shrqat 9.335 , 0.994 , 1.320 and 2.184 and the minimum in Balad 6.875 , 0.589 , 0.979 and 1.226 Bq.L^{-1}

Table (1) where average natural radioactivity (C) for wall water at unite (Bq.L^{-1})

Location	Test	^{40}K	^{238}U	^{222}Rn	^{226}Ra
Tikrit	C1	8.736	0.754	1.094	1.972
Bieja	C2	9.408	0.891	1.287	2.091
Dour	C3	8.576	0.688	1.102	1.755
Samara	C4	8.361	0.621	1.113	1.624
Shrqat	C5	9.335	0.994	1.320	2.184
Tuz	C6	8.759	0.887	1.234	2.052
Balad	C7	6.875	0.589	0.979	1.226
Dujaeil	C8	7.121	0.599	0.993	1.307

The mean activity concentrations in the well water in rock were depending on the radionuclide from 2 to 10 times higher than in well water soil therefore the low activity concentration in the water from the water in south Salahuddin (Balad) were due to the fact that do not rock and levels of radioactivity concentration in water depends on some factor such as geologic nature for the area including the study and weather since high activity concentrations of ^{226}Ra and other radionuclide in the north Salahuddin (Shrqat) were the radon levels are present in the granite and grandiosity rocks that spread in mountains and Such materials are rich also in uranium. In Table (2) we give the detection limit of the activity concentration of present study compared to the world data.

Table (2) the limit activity concentration (Bq.L^{-1}) in ground water compared to world data.

Word (source)	**^{238}U**	**^{226}Ra**	**^{222}Rn**	**^{40}K**
Austria [9]	0.004 – 1.00	0.037 – 0.55	100 – 900	—
Egypt [10]	—	0.008 – 0.04	—	0.025 – 0.344
Finland [11]	0.015 – 0.26	0.02 – 0.05	0.05 – 0.61	—
North Iraq [12]	—	2.494 – 8.28	—	43.7 – 140.3
Present study	0.589 – 0.994	1.226 – 2.184	0.979 – 1.32	6.875 – 9.408

The effective annual dosage and the lower value were measured for person when drink 1 Liter of water, where the higher value is 12.09 µsv.y^{-1} in sample of well water within Shrqat area and lower value is 6.16 µsv.y^{-1}from well water of Balad. Inhalation is 6.01 µsv.y^{-1} that considers higher value and 4.32 µsv.y^{-1} that represent lower value. The mean of annual effective dosage in studied well water in Salahuddin governorate is 9.44 µsv.y^{-1} in case where drinking and 5.02 µsv.y^{-1} in inhalation which lower than normal rang that is equal to 20 µsv.y^{-1} [13] . In Table (3) we give the average effective dose compared to the world data.

Table (3) the average effective dose compared to the world data.

Country	**Effective dose mSVy^{-1}**	**References**
Duhok governorate(Kurdistan, Iraq)	0.0611	[12]
World average value	0.5	[14]
Pakistan Gilgil city	0.04	[15]
India	0.11	[16]
Turkey	0.055	[17]
Egypt	0.05	[18]
Cyprus	0.018	[19]
Iraq Salahuddin	0.00944	Present work

CONCLUSION

Natural radioactivity in ground water has been found to be very similar. The overall radio activity concentration is dominated by that of ^{222}Rn in north Salahuddin while in the south Salahuddin area the concentration of ^{222}Rn is lower, for other radioactivity Whichever present in granite and grandiosity rocks that spread in Makhol Mountains. Such materials are rich in uranium. Different radionuclides have been included in the radioactivity estimates and comparison of the result was therefore difficult. However the result indicated that large variation exists in radioactivity estimates in Shrqat, Bieja, Tikrit and Tuz all these region, ^{222}Rn caused the largest part of the radioactivity and doses.

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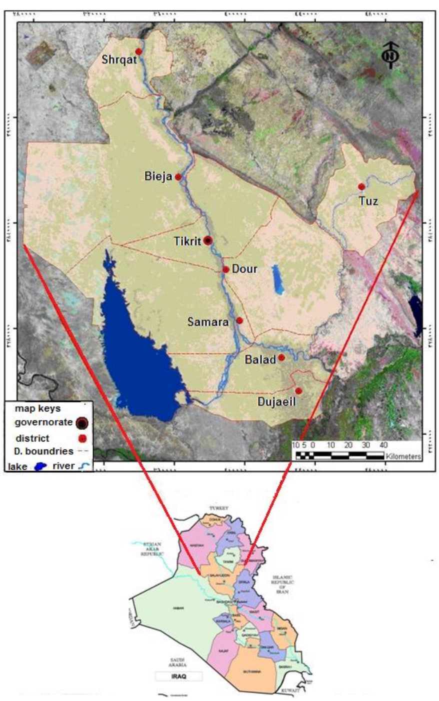

Fig (1) Region of study

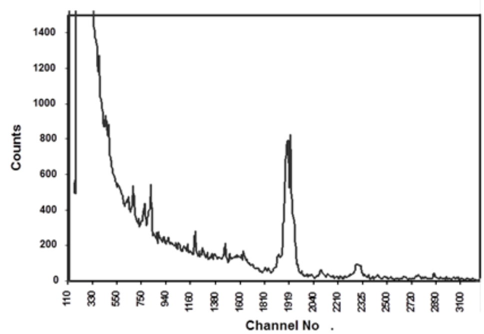

Fig. (2) Including Specter shape in Shrqat

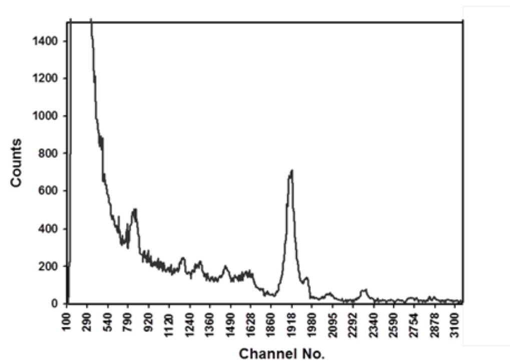

Fig. (3) Including Specter shape in Bieja

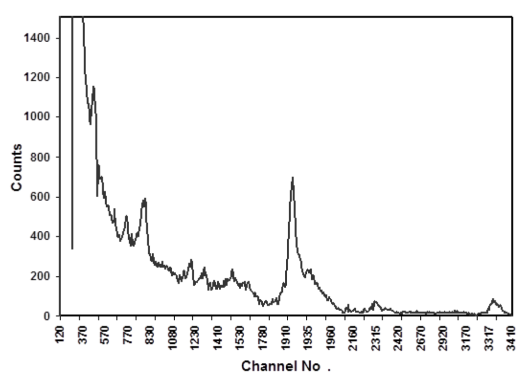

Fig. (4) Including Spector shape in Tikrit

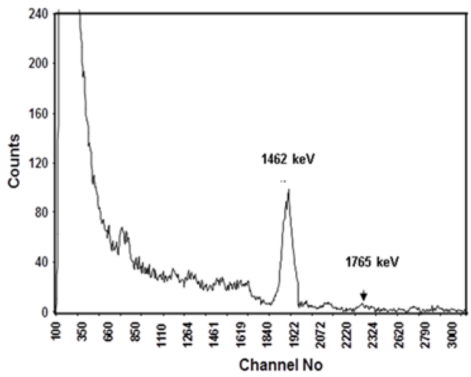

Fig. (5) background radioactivity in Salahuddin governorate